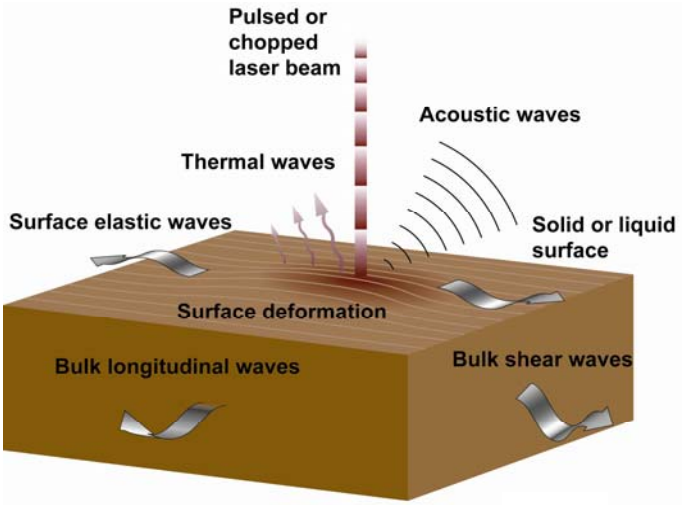
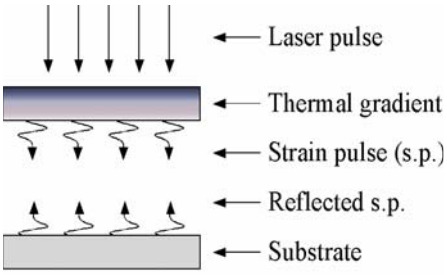
Idaho National Laboratory

Picosecond Ultrasonics (Pump/Probe)

Laser generation of acoustic waves

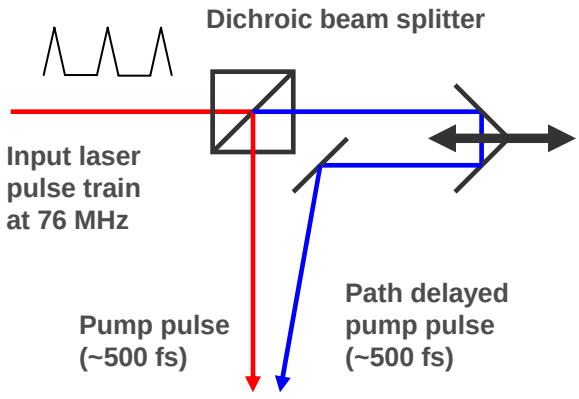


Generation Mechanisms
- thermoelastic
- deformation potential
- piezoelectric



The response of a material irradiated by a pulsed or chopped laser beam. Surface acoustic waves are confined to the near surface region of the sample while bulk wave travel throughout the sample.

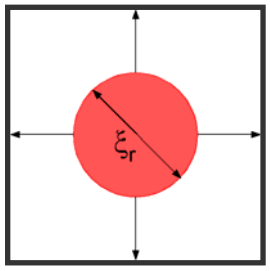
Pump/probe technique



The pump generates an acoustic disturbance. The path delayed probe then measures acoustic strain modulation of the optical reflectivity or out-of-plane surface motion at one instant in time (instant in time~500 fs). Time is index by increasing the optical path of the pump.

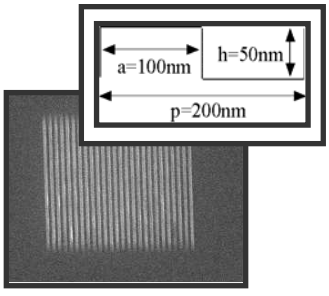
Bandwidth considerations

Conventional



- ξ_r~1μm
- $\tau \sim v_r \xi_r$ ~ 1 ns

Lithographic grating



- ξ_r~100nm
- $\tau \sim v_r \xi_r$ ~ 50ps

The bandwidth for bulk waves and surface acoustic waves is related to the acoustic transit time across the skin depth and optical spot size respectively.

David Hurley, Idaho National Laboratory, David.Hurley@inl.gov, (208) 526-3665